

## Unit 1: Safety First

Unit 1 Vocabulary

Unit 1 Concepts

Unit 1 Performance Objectives

1.1 – Safety First

1.2 – Your Safety Responsibility

1.3 – Establishing a Safety Culture

1.4 – Workshop Safety Issues

1.5 – Workshop Safety Rules

1.6 – Soldering Safety Rules

1.7 – Educational Regulations

1.8 – Drone Registration

1.9 – Definition of Recreational Use

1.10 – Safe Flying Locations

1.11 – Safe Weather Conditions

1.12 – Safe Flight Clearance

1.13 – Visual Line of Sight

1.14 - Start Out Slowly

1.15 – Propeller Dangers

1.16 – Pre-Flight Inspection

Unit 1 Summary

2.12 – Three Axes of Flight

2.13 – How Multicopters Fly

Unit 2 Summary

## Unit 3: Drone Configurations & Airframes

Unit 3 Vocabulary

Unit 3 Concepts

Unit 3 Performance Objectives

3.1 – Types of Small UAVs (sUAV)

3.2 – Choosing a Multicopter Configuration

3.3 – Current Uses and Future Potential

3.4 – Airframe Characteristics

3.5 – History of Helicopter Design

3.6 – Early Multirotor Aircraft Design

3.7 – Advancements in Control and Design

3.8 – Choosing/Building a Multicopter Configuration

3.9 – Airframe Sizes

3.10 – Airframe Materials

Unit 3 Summary

## Unit 2: Drone Overview & Flight Basics

Unit 2 Vocabulary

Unit 2 Concepts

Unit 2 Performance Objectives

2.1 – What is a Drone?

2.2 – Drone Reputation

2.3 – Development of Small UAVs

2.4 – What's in a Name?

2.5 – Drone Components

2.6 – What is Aerodynamics?

2.7 – Newton's Laws of Force and Motion

2.8 – Bernoulli's Principle

2.9 – Airfoils

2.10 – Four Forces of Flight

2.11 – Mechanical Design of an Airplane

## Unit 4: Motors & Propellers

Unit 4 Vocabulary

Unit 4 Concepts

Unit 4 Performance Objectives

4.1 – Introduction to Electric Motors

4.2 – AC/DC Differences

4.3 – Brushed vs. Brushless DC Motors

4.4 – Classification of Load Capability (Kv rating)

4.5 – Calculation of Motor Ratings

4.6 – Choosing the Best Motors for Your Needs

4.7 – Introduction to Propellers

4.8 – Propeller Design Theory

4.9 – Fixed Pitch, Variable-Pitch, and Constant Speed Blades

4.10 – Size, Pitch, Direction, and Blade Count

4.11 – Safety and Use of Prop Guards

4.12 – Balancing Your Propellers

4.13 – Materials Used in Prop Construction

4.14 – Choosing Your Propellers

Unit 4 Summary

## **Unit 5: ESCs & Flight Controllers**

Unit 5 Vocabulary

Unit 5 Concepts

Unit 5 Performance Objectives

5.1 – Introduction to ESCs

5.2 – ESC Ratings: Amperage and Voltage

5.3 – Calibrating and Programming ESCs

5.4 – Firmware Options (SimonK / BLHeli)

5.5 – A Few More Considerations

5.6 – Mounting Your ESCs

5.7 – Introduction to Flight Controllers

5.8 – Sensors and Guidance Systems

5.9 – Autonomous Flight

5.10 – Sense-and-Avoid Technology

5.11 – Determining Your Flying Purpose

Unit 5 Summary

## **Unit 6: Batteries, Chargers & LiPo Battery Care**

Unit 6 Vocabulary

Unit 6 Concepts

Unit 6 Performance Objectives

6.1 – Batteries Defined

6.2 – Anatomy of a Battery

6.3 – Battery Reactions and Chemistry

6.4 – Battery Purposes

6.5 – Battery Arrangement and Power

6.6 – Rechargeable Batteries

6.7 – LiPo Batteries: The Power of Choice for Drones

6.8 – LiPo Battery Characteristics

6.9 – LiPo Cell Balancing

6.10 – LiPo Chargers

6.11 – Use of LiPo Bags

6.12 – LiPo Battery Maintenance and Care

6.13 – Charging Temperatures

6.14 – Charging Rates

6.15 – Discharging Rates

6.16 – Working Temperatures

6.17 – Battery Puffing

6.18 – “Breaking-in” New LiPo Batteries

6.19 – Handling Damaged LiPo Batteries

6.20 – Storage and Shelf-Life of your LiPo Battery

6.21 – The 80% Rule: Retiring LiPo Batteries

6.22 – Disposal of LiPo Batteries

6.23 – Connectors

Unit 6 Summary

## **Unit 7: Transmitters, Receivers & FPV**

Unit 7 Vocabulary

Unit 7 Concepts

Unit 7 Performance Objectives

7.1 – What is a Radio Control System?

7.2 – Controllers / Transmitters

7.3 – Receivers

7.4 – Most Common Frequency Bands

7.5 – Control Station Setup and Programming

7.6 – First Person View (FPV)

Unit 7 Summary

## **Unit 8: Regulations & The FAA**

Unit 8 Vocabulary

Unit 8 Concepts

Unit 8 Performance Objectives

8.1 – The Need to Regulate Airspace

8.2 – The NTSB (National Transportation Safety Board)

8.3 – The FAA (Federal Aviation Administration)

8.4 – UAS Incidents and FAA Response

8.5 – Regulation of UAS Operations

8.6 – Definition of Recreational Use

8.7 – sUAS Registration

8.8 – Section 333 Exemptions

8.9 – Summary of Small Unmanned Aircraft Rule (Part 107)

8.10 – Future Challenges for Regulation

Unit 8 Summary

## CURRICULUM TIMELINE

This curriculum is thorough while allowing for flexibility. The instructor has the option to teach the entire curriculum and have the students compete all the activities, or the instructor can pick, choose, and/or skip any of the activities or quizzes. Instructors may also decide to include projects of their own. Below is a suggested timeline showing minimum and maximum days for each Unit.

(1 day = 60-minute class)

	Description	Minimum # days (if some activities are skipped)	Maximum # days (if all activities completed)
<b>Unit 1: Safety First</b>	Stresses the importance of adopting a "safety attitude" when building and flying a drone. Covers workshop safety and outdoor flying.	3	5
<b>Unit 2: Drone Overview &amp; Flight Basics</b>	Covers nomenclature, reputation, basic components, and current/future uses of drones. Introduces aerodynamics, Newton's Laws of Motion, Bernoulli's Principle, four forces of flight, three axes of flight, how they apply to drone flight.	4	6
<b>Unit 3: Drone Configurations &amp; Airframes</b>	Discusses AC/DC motor differences, brushed vs. brushless motors, Kv ratings, and calculation of motor capabilities for a drone build. Covers various configurations, airframe sizes, and construction materials.	4	6
<b>Unit 4: Motors &amp; Propellers</b>	Covers history of propeller design, fixed-pitch and constant speed blades, airfoil design, size, pitch, and blade-count. Includes balancing tips and construction materials.	4	6
<b>Unit 5: ESCs &amp; Flight Controllers</b>	Introduces role of ESCs, how they work, amperage and voltage ratings, ESC calibration, SimonK vs. BLHeli firmware options and BEC, OPTO, and UBEC. Introduces role of flight controllers, how they work, introduces sensors, sense-and-avoid technology, GPS, open source vs. closed source programming, and compares current FCs on the market.	4	6
<b>Unit 6: Batteries, Chargers &amp; LiPo Battery Care</b>	Covers definition, various makeups, reactions and chemistry, parallel vs. serial arrangements, rechargeable batteries, LiPo battery characteristics, charging, cell balancing, and various connectors. Stresses safety when using LiPo batteries including proper charging methods, discharging, handling, and disposal.	5	7
<b>Unit 7: Transmitters, Receivers &amp; FPV</b>	Introduces controllers, transmitters, and receivers, frequency bands, and programming transmitters. Discusses FPV.	3	4
<b>Unit 8: Regulations &amp; The FAA</b>	Covers role of the FAA and NTSB. Stresses importance of regulation, and lists registration and recreational use of drones. Section 333 Exemptions and Part 107 Rules are explained.	3	4
	<b>TOTALS:</b>	<b>30</b>	<b>44</b>